(12) UK Patent Application (19) GB (11) 2 241 915 (13) A

(43) Date of A publication 18.09.1991

(21) Application No 9006077.3

(22) Date of filing 17.03.1990

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(51) INT CL[5]
B26F 1/26 // D21F 7/08

(52) UK CL (Edition K)
B4B B70G
D1R RGQ R104 R151 R200 R501 R547 R624 R642
U1S S1666

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(58) Field of search
UK CL (Edition K) B4B, C3V VBC, D1R RGQ
INT CL[5] B26F

(54) **Production of perforate structures**

(57) In a method of producing apertured sheet material, a layer 23 of photopolymeric resin material is applied to a moving band 22, an apertured mask 26 which moves in synchronism with the support surface is positioned to overlie the resin material, and the resin material is irradiated, by e.g. ultra violet light or electron beam through the mask to effect an at least partial cure thereof in regions in register with the apertures (13, Fig 1) in the mask. After irradiation, uncured regions of the layer 23, are removed by pressure fluid jets at 33 and final curing of the resin material is effected at 35. The apertured sheet material which may be a blend of acrylated esters and/or urethanes and a photo initiator, reinforced with yarns or fibres, is of use in producing fabrics for, *inter alia*, the papermaking industry.

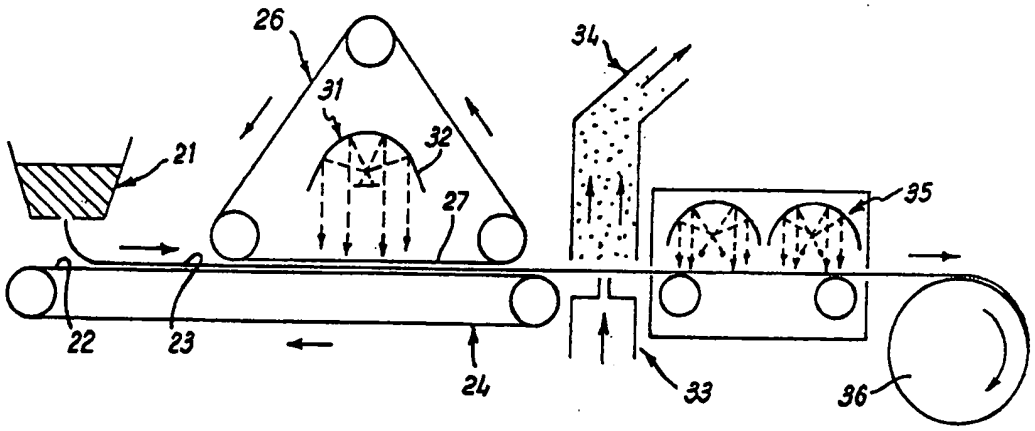

FIG.2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

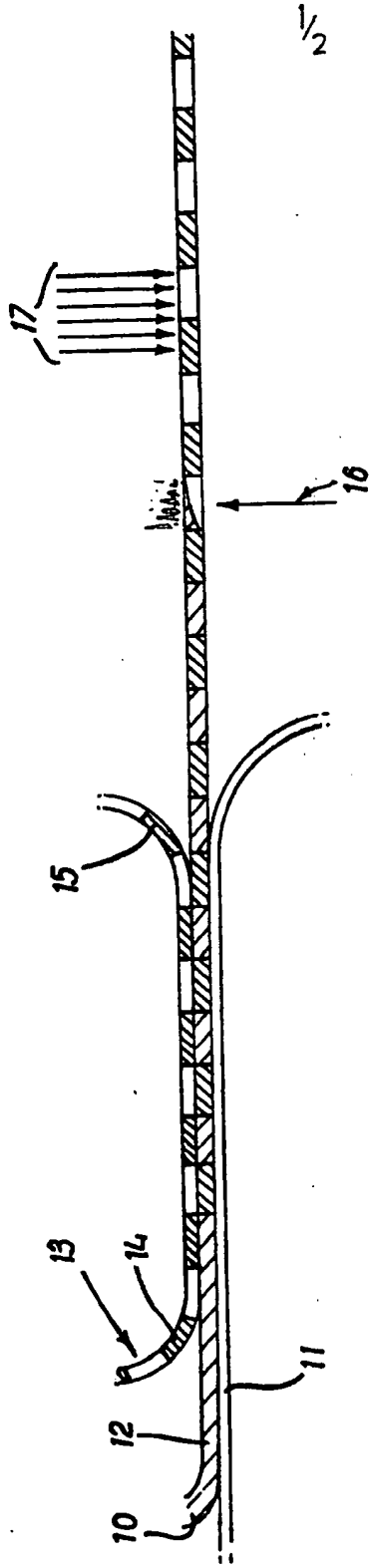

FIG.1

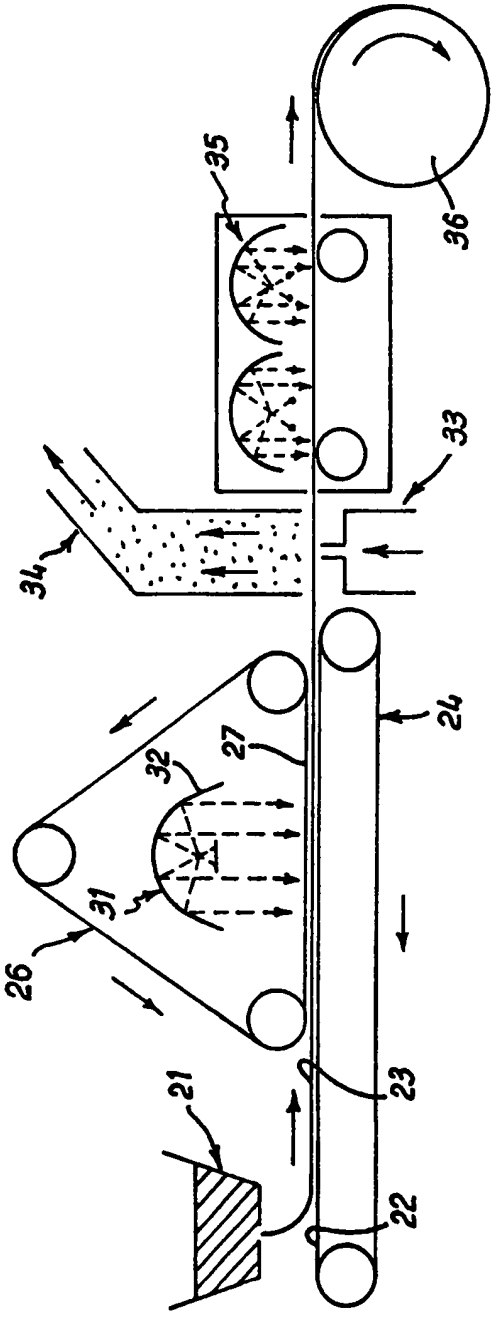

FIG.2

PRODUCTION OF PERFORATE STRUCTURES

The invention concerns the production of perforate structures and has particular, though not exclusive, reference to flexible structures for use in the papermaking industry.

It is of importance to the production of papermaking and like fabrics that the fabric be of a predetermined and sensibly consistent permeability in order that uniformity of drainage/drying according to the particular stage of the papermaking process involved, might be achieved throughout the full areal extent of the paper sheet as it moves through the papermaking machine.

Conventionally papermakers fabrics include, for example, woven structures or structures defined by interdigitated helical coils to either of which structures there may be added one or more batts of textile fibres. Permeability of the fabric may be reduced by including stuffer yarns in the cross-machine direction of the fabric, be it a woven fabric or a link-belt defined by side-by-side coils, or, in the case of a link belt, by impregnating the same with a foam material or by including strips of an elongate material within some at least of the individual coils.

Accuracy and uniformity of permeability, whilst being controllable in the prior structures, is not ideal, and it is the primary object of the present invention to provide a means whereby specific requirements of a fabric as regards its permeability might more readily be attained in a simple and economic manner.

According to the present invention there is proposed a method of producing a permeable fabric which comprises the steps of providing a layer of light curable polymeric resin material in fluid form, illuminating said layer of material through a mask selectively transparent to the illumination so as to effect at least partial curing of the material of the sheet in positions corresponding with the transparent regions of the mask, removing uncured polymeric material and effecting any necessary full cure of the residual such material.

The invention also includes apparatus for use in producing the method aforesaid which comprises feed means for delivering fluid polymeric material, a support means to receive said material from the feed means, a source of illumination positioned to illuminate polymeric material present on the support means, the source of illumination being adapted to direct sensibly parallel light towards the support means, and a transparent mask intermediate the source of illumination and the support means and through which light moves to polymeric material positioned thereon, the mask being selectively transparent in accordance with opaque patterning applied thereto.

According to a preferred feature, the support means is defined by a continuously moving band and the mask comprises an endless loop having a run arranged in spaced parallel disposition relative to the support surface and advanced at a like rate to the movement of the band.

According to a further preferred feature, the feed means comprises a curtains coater delivering a continuous sheet of fluid polymeric material to the support surface.

The invention will now be described further, by way of example only, with reference to the accompanying drawings in which : -

Fig. 1 is a diagrammatic illustration of the successive steps in the method of the invention; and

Fig. 2 is a diagrammatic view of apparatus for use in practising the invention.

Referring now to Fig. 1 of the drawings, a photopolymeric resin material 10 is applied to the surface of a moving conveyor belt 11, the viscosity of the resin being such as to form a layer 12 of uniform thickness thereon, and a selectively transparent mask 13 is brought into closely spaced relationship with respect to the upper surface of layer 12 for advancing movement therewith. The band 12 includes transparent and opaque regions 14, 15 respectively.

The layer 12 of resin material is subjected to illumination, through the mask 13, of a kind such as will effect at least a partial cure of that material in locations thereof in register with the transparent regions 14 of the mask, the illumination being in a direction normal to the surface of the mask.

After illumination, the mask is moved away from the surface of the layer of photopolymeric material, and such material advances to be subjected to a localised jet of

pressure air, as at 16, whereby uncured polymer is removed, thus creating apertures in the partially cured layer in positions corresponding to the opaque regions of the mask.

The apertured resin sheet is then subjected to further illumination so as fully to cure the resin, as at 17.

Apparatus suitable for practising the method is shown diagrammatically in Fig. 2 and will be seen to comprise a curtain coater 21 which supplies a layer 23 of a light-curable material of uniform thickness to the support surface 22 of an endless band 24, the support surface 22 having an easy release characteristic relative to the light-curable material and is typically of polytetrafluorethylene.

An endless mask 26 is positioned above the band 24, a lower run 27 of the mask being spaced from the support surface 22 by an amount sufficient to accommodate the material layer 23 present on the support surface 22 and to provide a small clearance between such material layer and the mask. The mask 26 is driven at a like linear speed to that of the endless band 24, and the "laminate" of the lower run 27 of the mask 26, the material layer 23 and the support surface 22 of the endless band 24 move together.

Mask 26 is selectively transparent, in the sense that regions are provided thereon which are opaque to the radiation necessary to effect curing of the light-curable

material, the regions, in the case under consideration, being circles of small diameter provided at close centres.

An elongated ultra violet light source 31 is provided within the loop of endless mask 26, the light source 31 further including a parabolic reflector 32 so positioned as to deliver parallel ultra voilet light to the mask in a direction perpendicular thereto.

The apparatus further includes pressure fluid means 33, preferably a compressed air jet, at a position downstream both of the mask 26 and the band 24, there being extractor means 34 arranged in register with the pressure fluid means 33 and at the opposite side of the layer 23 with respect thereto.

An additional curing means 35 is included downstream of the pressure fluid means 33, the radiation supplied by said curing means being of a kind appropriate to effect curing of the photopolymeric material.

The apparatus is completed by a take-up roll 36 to receive fully cured apertured material.

In one particular example the photopolymeric material used consisted of a blend of acrylated esters and/or urethanes and a photo initiator. The acrylate moieties are the active centres in so far as curing is concerned and the initiator is based on acetophenone. A 1 mm thick layer of the photopolymeric material was laid on the support surface and the mask was so positioned that the lower

run thereof was spaced from the surface of such material by a distance of 1 2 nm. The light source, which source was positioned 1 metre above the photopolymeric material, was such as to provide radiation of a dominant wavelength (Lambda max.) of 365 nm to give a partial core time of 30 secs. The apertures in the mask were circular in form, each being 1 mm in diameter and being provided at 2 mm centres.

It is to be appreciated that the thickness of the material layer and the geometry of the individual apertures and their disposition, will be selected according to particular requirements, and that the core time will vary appreciably according to the intensity of the illumination and the spacing of the light source from the photopolymeric material.

Furthermore, it is to be understood that the wavelengths of the ultra-violet light emitted by the source will extend over a range of between 250 to 400 nm, although the initiator reacts to wavelengths within a narrow band of, say, 360 - 370 nm. The light source will, of course, be selected having regard to the wave-lengths required to effect reaction of the initiator included in the photopolymeric material. It is to be appreciated that the method and apparatus as aforesaid will allow of the production, as a continuous process, of apertured sheet material in a simple and economic manner. The thickness of the sheet may be varied to suit particular requirements,

whilst the particular formulation for the photopolymeric material will be selected having regard to the characteristics required in the end product.

If it is required to improve the tensile strength of the sheet material, yarns and/or fibres may be included in the mix applied to the support surface 22 of the endless band 24.

The facility for selective curing of the material applied to the support surface 22 of the endless band 24 which arises from the use of a mask provides for the production of apertured structures of a broad range of permeabilities and this merely by suitable selection of aperture size and spacing. As will be recognised the method of the invention does make possible the creation of a graded permeability towards the edges of the sheet merely by use of a mask of an appropriate form.

The form of reflector is intended to ensure that the light reaching the mask is parallel light, thereby to ensure accuracy in aperture form and size, although it is thought that, by judicious selection of the light source and reflector, apertures having cross-sectional dimensions which vary progressively in the thickness direction of the material may be possible.

Whilst the invention is described in the context of irradiation by ultra voilet light, it is to be recog-

nised that other energy sources may be utilised, and in this regard mention is made of such as an electron beam as a source of radiation.

The apertured structure as aforesaid, whilst being intended primarily as a fabric for use in the papermaking and like industry, is thought to be of application in other contexts.

The apertured structure as aforesaid is of application as a papermakers' dryer fabric, and may be combined with a textile batt, as, for example, by applying a thin apertured structure in accordance with the invention to one or both faces of a textile batt, to form a papermakers wet felt.

CLAIMS

1. A method of producing a permeable fabric comprising the steps of providing a layer of light curable polymeric resin material in fluid form, illuminating said layer of material through a mask selectively transparent to the illumination so as to effect at least partial curing of the material of the sheet in positions corresponding with transparent regions of the mask, removing uncured polymeric material and effecting any necessary full cure of the residual such material.

2. The method as claimed in claim 1, wherein the illumination comprises parallel light directed perpendicularly of the mask.

3. The method as claimed in claim 1 or claim 2, wherein uncured polymeric material is removed by fluid under pressure.

4. Apparatus for the production of permeable fabrics comprising feed means for delivering fluid polymeric material, a support means to receive said material from the feed means, a source of illumination positioned to illuminate polymeric material present on the support means, the source of illumination being adapted to direct sensibly parallel light towards the support means, and a transparent mask intermediate the source of illumination and the support means and through which light moves to polymeric material positioned thereon, the mask being

selectively transparent in accordance with opaque patterning applied thereto.

5. Apparatus as claimed in claim 4, wherein the support means comprises a continuously moving band and the mask comprises an endless loop having a run arranged in spaced parallel disposition relative to the support surface and advanced at a like rate to the movement of the band.

6. Apparatus as claimed in claim 4 or 5, wherein the feed means comprises a curtain coater positioned and adapted to deliver a sheet of fluid polymeric material to the support surface.

7. Apparatus as claimed in any one of claims 4 to 6, wherein the source of illumination includes a parabolic reflector positioned to deliver parallel light to the mask in a direction perpendicular thereto.

8. Apparatus as claimed in claim 5, or in claim 6 or 7 when dependant thereon, wherein the source of illumination is disposed within the endless loop forming the mask and is co-extensive with the band in the widthwise direction thereof.

9. Apparatus as claimed in any one of claims 4 to 8, further including means adapted to remove uncured polymeric resin material, said means including a source of fluid under pressure adapted to apply a localised jet or jets of pressure fluid to an at least partially cured polymeric resin material existing on the support means.

10. Apparatus as claimed in claim 9, further including additional curing means downstream of the means adapted to remove uncured polymeric resin material.

11. An apertured polymeric resin material produced in accordance with the method claimed in any one of claims 1 to 3.

12. Apertured polymeric resin material as claimed in claim 11, including a reinforcement comprising yarns and/or fibres therein.

13. Apertured polymeric resin material as claimed in claim 11 or 12, laminated with a textile batt.

14. The method of producing a permeable fabric substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

15. Apparatus for use in the production of permeable fabrics substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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